Innovation policy, entrepreneurship, and development: a Finnish view

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Innovation Policy, Entrepreneurship, and Development: A Finnish View

Otto Toivanen*

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Abstract

This article first reviews the economic rationales for innovation policy. It then describes the Finnish innovation policy and policy making environment. The Finnish policy is evaluated from the point of view of fostering entrepreneurship. R&D subsidies, the main tool of Finnish innovation policy, may not be a very effective way of fostering entrepreneurship, compared to R&D tax credits of the type used in the Netherlands and Norway. The main reason for this is that the latter provide support in a more transparent way. The article ends with a discussion of what lessons the Finnish innovation policy offers to developing countries.

Keywords: innovation policy, R&D subsidies, R&D tax credit, developing countries, interim efficiency, market failure
JEL classification: L53, O25, O28

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Abbreviations

FFI	Finnish Foundation for Innovation
GPTs	General purpose technologies
ICT	Information and communication technologies
R&D	Research and Development
SME	Small and medium sized enterprises
Tekes	National Technology Agency of Finland
USPTO	US patent and trademark office
VTT	Technical Research Centre of Finland

Tables and figures appear at the end of this paper.

1 Introduction

At least since the 1950s it has been recognized that innovation is central to economic growth. It has also been well understood that innovations both generate and rely on externalities. These twin facts, together with market failures most often thought to arise in financing of innovation, serve as the basic justification for public sector actions which nowadays are jointly labelled innovation and research policies. These have their roots in the policies following the Second World War (e.g. Mowery 1995) that rose to prominence, e.g. in the EU's Lisbon strategy.[1] R&D subsidies are one of the most important tools of innovation policy in practice (Nevo 1998) and one that has theoretical justification in the endogenous growth literature (e.g. Howitt 1999; Segerstrom 2000). It therefore seems worthwhile to consider the theory and practice of R&D subsidy policy in some detail. A key characteristic of R&D subsidies—one that is of great importance for both fostering entrepreneurship and implementing this policy in a developing country context—is that they are a policy tool that in practice requires active decisionmaking. That is, once a proposal has been received, the agency administering the programme has to make an active decision on whether or not to grant a subsidy, and if so, what the amount would be. This is unlike the other popular tool for enhancing R&D investments of firms, namely tax credits. It is my view that while the theoretical foundation for R&D subsidies is sound, the problems with implementation may call into question the justifiability of such policies.
After having reviewed the theoretical support for R&D subsidies and innovation policy in Section 2, I provide a brief review of the Finnish innovation environment in Section 3. In Section 4 I first review the general innovation support system. I then concentrate on R&D subsidies. In Section 5 I offer my view of the pros and cons of using R&D subsidies to promote entrepreneurship. In Section 6 I discuss the implementation of Finnish R&D subsidy policy in a developing country context, with special emphasis on entrepreneurship. Finally, in Section 7, are the conclusions.

2 Theoretical justifications for innovation policy

Externalities are the key justification for active government policy also in relation to innovative activities. As long as the benefits from innovative activities are not completely captured by whoever conducted them, there is a potential wedge between social and private benefits. As an example, think of a new good. As long as the firm developing the product does not capture the whole social surplus that the new product generates, there is room for government policy. The empirical literature on new goods typically finds large estimated consumer surpluses from new innovations.[2]

Knowledge spillovers to other innovators are another externality commonly linked to R&D and used as a justification for active government policy. The seminal paper of Jaffe (1986) found that other firms' R&D affected the productivity of firm R&D positively. In later work Jaffe (1989)

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1 See e.g. http://europa.eu.int/comm/enterprise/innovation/communication.htm

2 Examples of studies with such findings are Trajtenberg's (1989) analysis of computerized tomography scanners, and Petrin's (2002) analysis of the introduction of minivans in the USA.

found that university R&D has a positive direct effect on commercial innovation as measured by patents at least in some industries, and a positive indirect effect by increasing industrial R&D. A little later Jaffe et al. (1993) looked at patent citations. They found that citations from later patents to earlier patents are greatly affected by geography, whereby a new patent is more likely to cite a patent that was granted to an applicant which is geographically close to the new applicant.

Market failure in supply of finance to innovation has provided motivation for various policies aimed at supporting private sector R&D. Notice that this is a market failure that comes on top of any product market externalities. Financial market imperfections thus potentially provide an additional and independent motivation for government intervention. Himmelberg and Petersen (1994) put this hypothesis to test by studying the sensitivity of R&D investments to cash flow. Using data from small US firms they find evidence in favour of financial constraints. Hyytinen and Toivanen (2005) find evidence that in Finland the availability of government support affects most firms in industries that are relatively dependent on external financing.

Finally, several of the above mentioned market imperfections may take added relevance in the case of so-called general purpose technologies (GPTs) (Bresnahan and Trajtenberg 1995). Often cited examples of GPTs are steam, electricity, and semiconductors. GPTs give an extra role to innovation policy in that they easily feature ‘multiple equilibria’. This means that in practice, if GPTs are important, to push a country from a ‘low activity equilibrium’ to a ‘high activity equilibrium’ with good policy may be possible.

The above discussion may lead one to think that there is plenty of scope for government action. Any identified market failure calls for government intervention of some sort. This optimistic view may be unwarranted: such a conclusion makes strong demands on a governments’ ability to design policies that would rectify identified market failures. One has to take into account the government’s ability to deliver, too.

In real life, governments face informational constraints that may be as or more severe than those of firms. Modern economics has analysed markets that are *interim efficient*.[3] In such a case, a benevolent social planner could not improve on the market outcome, if she is subject to the same informational problems as the market. From this vantage point, many phenomena are no more market failures that call upon government action.

The government has one unique advantage over the private sector, though: it is in a unique position in that it need not necessarily cover the costs of information gathering and dissemination by the revenues so generated. This means that an active government may in some circumstances be able to achieve better than interim efficient outcomes.

The foregoing example raises an important point, namely the heterogeneity of the innovation policy environment. Firms, R&D projects, and innovations are highly heterogeneous. This means that a policy that is optimal in the strict sense of achieving Pareto efficiency should vary not only

3 This concept was introduced by Holmström and Myerson (1983).

from firm to firm, but from project to project. This is what puts a government agency running and the R&D subsidy programme under considerable informational requirements.

3 Innovation in Finland

R&D and innovation are important for the Finnish economy: as an example of the plentiful evidence, Jalava and Pohjola (2008) estimate that Finnish growth without ‘the success information and communication technologies (ICT) manufacturing’ would have been 0.9 percentage points lower during 1990–2004.

R&D activities in Finland are characterized by active government involvement and planning on the one hand, and dominance of a few large firms on the other hand. Three key facts provide a way to summarize Finland from the point of view of innovation policy, and these are provided by Figures 1 and 2 and Table 1. Figure 1 shows the aggregate inputs into R&D as a percentage of GDP. Finland exhibits a consistent upward trend, Sweden being the country that invests most in R&D in relation to its GDP.

Figure 2 shows the number of scientific publications per 1000 inhabitants. Finland produces a relatively large number of publications for its size, producing some 30 to 40 per cent more publications per inhabitant than e.g. Norway, a country of similar characteristics. The first message from Table 1, exhibiting statistics on US patents, is the one pointed out in Trajtenberg (2001): what matters in the end is not how intensive or successful R&D is in relative terms, but in absolute terms. This is especially true in the case of technologies where patents are an effective way to protect intellectual property (such as in the pharmaceutical industry). Taking this into account, Table 1 shows that Finland is doing very well considering its size. Israel and Finland—along with some of the Asian Tigers—belong to the small group of countries that have been able to significantly improve their innovative output as measured by US patents.

The overall picture that emerges is that pointed out by Trajtenberg (2001): Finland has succeeded in transforming itself by increasing its R&D inputs to a level seen only in a few other countries, in raising the output of the innovation sector to relatively good levels both in terms of scientific (academic publications) and commercial (patents) output.

4 R&D subsidies in Finland

4.1 The Finnish innovation policy environment

In this section, I briefly describe the overall structure of institutions of innovation policy in Finland as they now stand. In a recent evaluation of the Finnish innovation support system, Georghiu et al. (2003) provide a description and also a short overview of the historical development of the system. The Finnish government—as many other governments—employs several agencies to conduct innovation policy. The most important ones are depicted in Figure 3. The Academy of Finland is the main source of government funding for basic research, but it nowadays also funds applied research. The government runs a number of research institutes. Of these, the most important one is VTT, the technical research centre. The Finnish Foundation for

Innovation's (FFI) objective is to help individuals and small and medium sized enterprises (SMEs) in protecting their intellectual property. The regional dimension is taken care of through 15 TE-centres. These are regional government offices whose task is to provide business support services, consultation and advice, as well as finance to SMEs. The National Technology Agency of Finland (Tekes) is the main organization of Finnish innovation policy. Tekes provides funding (e.g. it is the sole source of R&D subsidies), expert advice and promotion of national and international networking. Below I will discuss in more detail Tekes' main activity, the provision of R&D subsidies. Finnvera is a state-owned financing company whose main tasks are to promote entrepreneurship, development of SMEs, internationalization and exports of firms, and government regional policy. Only a comparatively small part of Finnvera's activities fall under innovation policy. Finnish Industry Investment and Sitra are the venture capital funds of the government, although the latter has lately greatly reduced its activities in this field. Finally, Finnpro is the responsible organization for providing business support services for the internationalization of firms. Taken together, these organizations provide the Finnish government with a large set of tools to conduct innovation policy (for details, see Georghiu et al. 2003). Figure 4 shows the relative funding of the main innovation funding institutions—all of the above are not included because the share of innovation policy related to their remaining activities is small (e.g. Finnvera).

In Finland, the interaction between policymakers and policymaking bodies and interest groups is explicitly organized. This fact is reflected in the Science and Technology Policy Council of Finland. The Council, chaired by the Prime Minister, is 'responsible for the strategic development and coordination of Finnish science and technology policy as well as of the national innovation system as a whole'.[4] The current composition of the Council is given in Table 2. The Table shows the representation of the interest groups, as the Council members represent the most important ministries, the industry, the labour unions, and academia.

While Finland in many ways may be deemed a success in terms of its innovation policy, it is much harder to pinpoint what parts of the policy have been most crucial. To mention one often neglected feature (pointed out by Georghiu et al. 2003), since the early 1970s there has been a steady increase in the number of graduating engineers and scientists.

4.2 Tekes

Tekes is the main innovation policy tool and administers R&D subsidies. It is therefore worth describing in a little more detail how Tekes operates in this regard. Tekes' main objective is to promote the competitiveness of the Finnish industry and the service sector by providing funding and advice to both business and public R&D. Tekes decisionmaking is constrained by rules that dictate that the maximum subsidy is 50 per cent of incurred costs (60 per cent for medium sized and 70 per cent for small enterprises). In case of cooperation, these funding limits may be exceeded. Besides firms' R&D projects, Tekes funds feasibility studies and university research. Tekes receives some 3000 applications per year, half of which are for business sector R&D projects, some two thirds of which are accepted. Tekes grants around 300 million Euros in subsidies and loans to companies. In 2007, Tekes funded 695 microenterprise projects with a

4 See http://www.minedu.fi/tiede_ja_teknologianeuvosto/eng/index.html

total of 69 million Euros; 408 small enterprise projects with a total of 73 million Euros; 152 medium sized enterprise projects with a total of 19 million Euros, and 295 projects by large firms with 123 million Euros (Tanayama 2005). Tekes takes unsolicited applications, but also runs special programmes. The latter are usually designed in close cooperation with the industry. Tekes has three funding instruments: grants (=subsidies), low interest loans and capital loans. Low interest loans not only have a low interest rate, but are also soft: if the firm can demonstrate that the R&D project failed, it may waive the payment in part or completely. Capital loans are a Finnish speciality: they are included in fixed assets in the balance sheet, can be paid off only when unrestricted shareholders' equity is positive and the debtor cannot give collateral. Tanayama et al. (2008) provide a description, a game theoretic model, and an empirical analysis of the application process. The application process goes as follows (see Figure 5): first, a firm makes an application. In the application, the firm describes the objectives and planned execution of the project, and a proposed budget. Firms are often in touch with Tekes officials prior to submitting the actual application. After receiving an application, Tekes screens it in a variety of dimensions. The decisionmaking body which decides both on the type and the amount of support varies depending on the amount of support (subsidy) to be decided upon as described in Table 3.

4.3 Tekes and entrepreneurship

Tekes is not the main Finnish policy tool to foster entrepreneurship (that is Finnvera), but it has currently specific policies that are aimed at newly established ventures. As reported below, quite a large number of microenterprise projects are funded by Tekes annually. Tekes[5] divides its special funding for young innovative companies into three stages: pre-stage funding, first stage funding and second stage funding.

Pre-stage funding is aimed at helping at the planning stage. Support at this stage can be used to develop a business plan that is based on a high technology or knowledge-intensive concept. First stage funding is available to those firms that have successfully completed the pre-stage, are small, less than 5.5 years old, and fulfil some other requirements. Those that are eligible have their proposals passed to a panel that consists mostly of venture capitalists. The role of the panel is to advice Tekes in decisionmaking.

In the second stage, only firms that are deemed to have a chance for rapid growth in international markets get funding. Funding is available for firms that are no more than eight years old, and funding is capped at 750.000 Euros.

While all Tekes programmes are evaluated, and Tekes commissions regularly research to assess the impact of its policies, I am not aware of any evaluations of the funding for young innovative companies as of yet; this is probably explained by the fact that this programme is very recent.

[5] See http://www.tekes.fi/rahoitus/yritys/nuoret_yritykset_esivaihe.html , accessed October 5th, 2008

5 R&D subsidies and entrepreneurship

As is hopefully clear from the above discussion, R&D subsidies are not directly aimed at promoting entrepreneurship in Finland—for this, there is an entirely different government agency. As is hopefully, however, also clear, Tekes does have policies directly aimed at start-ups and hence, fledgling entrepreneurs.

There are a number of obstacles that hinder the use of R&D subsidies in promotion of entrepreneurship. One is that subsidies in most countries are paid *ex post* against receipts. If it is the case that (new) entrepreneurs are credit constrained, this type of funding may be of little help. Second, (while quite fast), the speed at which the decisionmaking progresses in Tekes may be too slow for an entrepreneur. This may sound trivial, but is not so at all; also, this may be hard to rectify. The reason for the former is that an entrepreneur may indeed need to move fast in order to e.g. secure funding for R&D. The reason for the latter is that the essence of R&D subsidies is that they are tailored application by application. This tailoring is the greatest asset of R&D subsidies in comparison to R&D tax credits and almost by definition leads to an application process that may be too slow for especially small firms.

Both of these aspects generate opportunity costs to entrepreneurs and indeed, Takalo et al. (2008) find that the application costs of those that do not apply may be quite high. They also find that application costs are decreasing in size of the firm (measured by the log of the number of employees)—a finding that suggests that entrepreneurs may be at a disadvantage from this point of view. An example of an application cost (for R&D subsidies) that is generated through opportunity costs is the increased risk for a (small) company not to be able to launch its product to the market place before its rivals—the potential loss of a first mover advantage. One should not underestimate the severity of such costs.

While thus a potential obstacle, the fact that R&D subsidies are tailored is also their biggest asset in terms of promoting entrepreneurship. If one is able (e.g. the legislation does not rule out the possibility) to explicitly target the support to certain types of firms, it may be possible to increase their likelihood of applying.

Another potential benefit of R&D subsidies is that the government may use them to generate externalities. The Finnish government (Tekes) does just this by requiring that a large firm has to cooperate with SMEs in order to be eligible for government R&D support. This may allow small firms and entrepreneurs to access information that would not be available to them otherwise. Finally, subsidies may act as a signal to private financiers. This can be the case if the government agency is good at finding out the type of the applicant—type here meaning ‘good’ (positive expected profits) or ‘bad’ (negative). Takalo and Tanayama (2008) provide a theoretical analysis of the circumstances under which the government may have such a ‘certification’ role.

Let us take as granted for the moment the need to foster innovation-oriented entrepreneurship. It could well be that R&D subsidies are not as good a policy tool for this purpose as some alternatives. Evidence seems to suggest that the hurdles to apply are high, the speed at which applications can be processed may be too slow, and opportunity costs of applying forbidding for those entrepreneurs who would be the target of such a policy. An alternative could be to offer R&D tax credits in such a way that even firms that do not make a profit can benefit from them.

Examples are given by the Netherlands, where the tax credit is based on the (R&D) wage bill, and by Norway, where the tax credit is paid even if the firm is not profitable.

Such arrangements take R&D tax credits very close to subsidies. This is indeed the case, but there is one big difference: in the Netherlands and in Norway, the process through which one becomes eligible (e.g. in Norway there is *ex ante* screening for tax credits, see Møen and Haegeland 2007) is much less arduous than the one a firm needs to traverse in order to obtain R&D subsidies.

6 R&D subsidies and entrepreneurship in a developing country

It is clear that the Finnish policy described and discussed above is tailored to Finnish needs, and therefore reflects the fact that Finland is a developed economy with a highly educated workforce. One may therefore wonder how much of the Finnish experience can be of use in a developing country context. As there is to my knowledge no research on such issues, what follows should be viewed as speculative.

A key characteristic of the Finnish innovation policy system has been that it has been quite predictable. It is clear that for any system to take root, information about it and its workings needs to spread among potential applicants. This may still be a problem in Finland; Tekes exists since a quarter of a century, is well known and receives a lot of media attention, but still only a relatively small proportion of Finnish companies apply for funding from Tekes. At any rate, however, it would seem that a key characteristic to copy into a developing country is the long term nature of the institutional arrangement.

A prerequisite of being able to administer an R&D subsidy programme is that the required human capital exists. One may copy institutional arrangements, but the institutions need to be manned by competent personnel. A key is to be able to recruit capable reviewers. Unless one succeeds in this, there is no hope of being able to reap the benefits that the system might otherwise offer.

A further ‘capability requirement’, a necessary condition really, is that there is a demand for such policy instruments. That most likely necessitates long term investments in the education sector, from bottom to top. It seems fair to state that a key feature of the Finnish innovation policy has been a determined effort to increase the educational level of the population, and especially, the investments in engineering education. This is reflected, e.g. in the fact that some 80 per cent of Finns obtaining a US patent and trademark office (USPTO) patent are engineers by training (Toivanen and Väänänen 2008).

There is also a danger that one should not forget: while the public sector intervention was motivated by the possibility of the public sector to be a focal point, this same argument may also carry a danger. If the government sector is successful in becoming the focal point of R&D support, this may paralyze private sector efforts. In practice, it could be that e.g. private venture capital markets are not born if the government crowds them out. There is to my knowledge no evidence of this having happened anywhere in general or in Finland in particular, but certainly this is an issue discussed by Finnish researchers regarding the Finnish R&D funding mechanisms.

While the message from the above analysis may be bleak, there is some evidence that public support to private R&D works (also) in developing countries. Hall and Maffioli (2008) analyse the effects of Technology Development Funds in Argentina, Brazil, Chile, and Panama, and find encouragingly large positive effects on R&D investments, but less encouragingly, little impact on patents, new product introduction, or productivity. One should also note that most of the countries studied by Hall and Maffioli differ from many developing countries in that they have a long history of investing (in relative terms) in higher education and research.

7 Conclusions

Innovation policy in general and R&D subsidies in particular are believed to be important in fostering economic growth. These beliefs are both held by politicians and backed by economic research. It is standard for researchers (e.g. Klette and Møen 1999) to voice concerns over political economy issues. These may lead to a situation where actual policies diverge from optimal ones. Government failure is the rubric under which one generally collects such problems. A potentially even more fundamental problem is that one should not use failure to be at a Pareto optimum as a justification for government intervention. A more reasonable, yet still challenging, yardstick would be to take seriously the informational constraints of the government when analysing the need for existing or new policies.

An important insight that can be derived even from the simplest model of R&D subsidies is that optimal subsidies are heterogenous, i.e., they ought to vary from firm to firm and from project to project, and that the informational demands for designing optimal policies are potentially prohibitive.

The description of the Finnish innovation policy reveals that it is at the same time overarching and pays attention to small details e.g. when screening R&D subsidy applications. The policy towards entrepreneurship has to a great extent been separated from innovation policy, although at least lately one can see that innovation policy is being engineered also towards newly established small firms.

While the Finnish innovation support system seems to function relatively well and the R&D subsidy part especially so, it is still an open question what their role is in Finland's transformation into an (more) innovation-driven economy. In particular, it is not clear to what extent Finnish institutional arrangements can be copied into other environments, and whether it makes sense to copy them piece meal or not.

Another lesson to be taken from small developed and R&D intensive countries such as Finland and Israel is that innovation—linked-based entrepreneurship can be fostered. A prerequisite for this is that the educational system harnesses individuals with the requisite skills; then and only then can active government policies towards entrepreneurship have the wish for consequences. Finland and Israel offer a contrast in this respect, as, at least as an approximation, the former is dominated by large companies in terms of innovation, the latter by small businesses. Small countries can overcome the deficit of size by determined efforts especially in higher education. Entrepreneurship, and especially entrepreneurship in connection to innovation, seems to hold the promise of economic prosperity and growth. Some characteristics of the Finnish policies, such as tying support to large companies to a requirement that they cooperate with small companies, may indeed be ones that could be worthwhile to copy into a developing country environment. Others, such as relying entirely or mostly on R&D subsidies, may be less promising. As so often, the devil is in the details.

References

Bresnahan, T., and M. Trajtenberg (1995). 'General Purpose Technologies "Engines of Growth"?'. *Journal of Econometrics,* 65: 83–108.

Georghiu, L., K. Smith, O. Toivanen, and P. Ylä-Anttila (2003). 'Evaluation of the Finnish Innovation Support System'. Finnish Ministry of Trade and Industry Publications 5/2003. Helsinki: Finnish Ministry of Trade and Industry.

Hall, B., and A. Maffioli (2008). 'Evaluating the Impact of Technology Development Funds in Emerging Economics: Evidence from Latin-America'. *European Journal of Development Research*, 20: 172–98.

Himmelberg C. B., and B. Petersen (1994). 'R&D and Internal Finance: A Panel Study of Small Firms in High-tech Industries'. *Review of Economics and Statistics,* 76 (1): 38–51.

Holmström, B., and R. Myerson (1983). 'Efficient and Durable Decision Rules with Incomplete Information'. *Econometrica*, 51: 1799–820.

Howitt, P. (1999). 'Steady Endogenous Growth with Population and R&D Inputs Growing'. *Journal of Political Economy,* 107: 715–30.

Hyytinen, A., and O. Toivanen (2005). 'Do Financial Constraints Hold Back Innovation And Growth? Evidence on the Role of Public Policy'. *Research Policy*, 34: 1385–1403.

Jaffe, A. (1986). 'Technological Opportunity and Spillovers of R&D: Evidence from Firms' Patents, Profits, and Market Values'. *American Economic Review Papers and Proceedings*, 76: 984–1001.

Jaffe, A. (1989). 'Real Effects of Academic Research'. *American Economic Review*, 79: 957–70.

Jaffe, A., M. Trajtenberg, and R. Henderson (1993). 'Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations'. *Quarterly Journal of Economics*, 108: 577–98.

Jalava, J., and M. Pohjola (2008). 'The Roles of Electricity and ICT in Economic Growth: Case Finland'. *Explorations in Economic History,* 45 (3): 270–87.

Klette, T., and J. Møen (1999). 'From Growth Theory to Technology Policy – Coordination Problems in Theory and Practice'. *Nordic Journal of Political Economy,* 25: 53–74.

Mowery, D. (1995). 'Survey of Technology Policy'. In P. Stoneman (ed.), *Handbook of the Economics of Innovation and Technical Change*. Oxford: Basil Blackwell.

Nevo, R. (1998). 'Trends and Patterns of Public Support to Industry in the OECD Area'. *STI Review*, 21: 12–4.

Møen, J., and T. Haegeland (2007). 'Input Additionality in the Norwegian R&D Tax Credit Scheme. Report 47. Oslo: Statistics Norway.

Petrin, A. (2002). 'Quantifying the Benefits of New Products: The Case of the Minivan'. *Journal of Political Economy*, 110: 705–29.

Segerstrom, P. (2000). 'The Long-run Growth Effects of R&D Subsidies'. *Journal of Economic Growth*, 5 (3): 277–305.

Tanayama, T., T. Takalo, and O. Toivanen (2008). 'Expected Benefits of Innovation Policy'. Mimeo. Helsinki: HECER.

Takalo, T., and T. Tanayama (2008). 'Adverse Selection and Financing of Innovations: Is there need for R&D subsidies?'. *Journal of Technology Transfer*, forthcoming. Available at: www.springerlink.com/content/51063718612w730j/

Takalo, T., T. Tanayama, and O. Toivanen (2007). 'Selection or Self-rejection? Applications into a Treatment Program: The Case of R&D Subsidies'. Discussion Paper 76. Helsinki: HECER.

Tanayama, T. (2005). 'Selective Public Business Funding – the Case of Tekes'. Mimeo. Espoo: VTT Technology Studies and Helsinki: HECER.

—— (2007). 'Allocation and Effects of R&D Subsidies: Selection, Screening and Strategic Behavior'. Doctoral Dissertation. Helsinki: Helsinki School of Economics.

Toivanen, O., and L. Väänänen (2008). 'Returns to Inventors'. Discussion Paper 237. Helsinki: HECER.

Trajtenberg, M. (1989). 'The Welfare Analysis of Product Innovations, with an Application to Computed Tomography Scanners'. *Journal of Political Economy*, 97: 444–79.

—— (2001). 'Innovation in Israel 1968–97: A Comparative Analysis Using Patent Data'. *Research Policy*, 30: 363–89.

Table 1. Figures on US patenting, various countries

Country	Patents per year		Patents per capita		Success rate in %		Annual growth rate in %	
	1968–97	1992–97	1968–97	1992–97	1968–97	1992–97	1968–97	1992–97
G7								
Canada	1525	2401	6.1	8.1	56	55	3.40	5.50
France	2423	2896	4.5	5	66	63	1.90	0.50
Germany	6338	7250	9.8	8.9	65	63	2.30	2.40
Italy	937	1197	1.7	2.1	59	58	2.80	0.40
Japan	13226	23847	11.5	19	65	61	8.40	2.80
UK	2547	2494	4.4	4.3	55	51	0.20	3.10
USA	46913	66325	19.8	25.2	62	59	1.60	5.30
Reference Group								
Finland	214	438	4.5	8.6	57	58	8.60	10.00
Ireland	35	60	1	1.7	49	48	6.80	5.50
Israel	234	577	5.3	10.2	54	56	10.10	13.30
New Zealand	42	61	1.3	1.7	42	42	4.90	16.90
Norway	101	137	2.4	2.9	-	-	4.93	4.26
Spain	105	173	0.3	0.4	49	50	4.20	3.10
Asian Tigers								
Hong Kong	39	95	0.7	1.5	49	46	12.50	9.60
Singapore	22	83	0.8	2.6	55	52	16.50	10.30
South Korea	443	1989	1.1	4.4	61	62	27.70	27.90
Taiwan	554	2006	2.8	9.3	44	47	33.80	15.70

Note: Trajtenberg (2001) and author’s own calculations using the NBER patent data for Norway.

Table 2: Science and Technology Policy Council of Finland

Chairman

Prime Minister Matti Vanhanen

Deputy Chairmen

Minister of Education and Science Sari Sarkomaa

Minister of Economy Mauri Pekkarinen

Minister Members

Minister of Finance Jyrki Katainen

Minister of Agriculture and Forestry Sirkka-Liisa Anttila

Minister of Labour Tarja Cronberg

Minister of Health and Social Services Paula Risikko

Minister of Culture and Sport Stefan Wallin

Members appointed by the Government

Development Manager Eija Hietanen, The Central Organization of Finnish Trade Unions SAK

President and COO Olli-Pekka Kallasvuo, Nokia Corporation

Director General Erkki K. M. Leppävuori, Technical Research Centre of Finland VTT

Chief Executive Marja Makarow, European Science Foundation

President Markku Mattila, Academy of Finland

CEO Pekka Mattila, Finnzymes Ltd.

Director General Veli-Pekka Saarnivaara, Tekes (Finnish Funding Agency for Technology and Innovation)

Rector Marja-Liisa Tenhunen, Central Ostrobothnia University of Applied Sciences

Professor Päivi Törmä, Helsinki University of Technology

Rector Keijo Virtanen, University of Turku

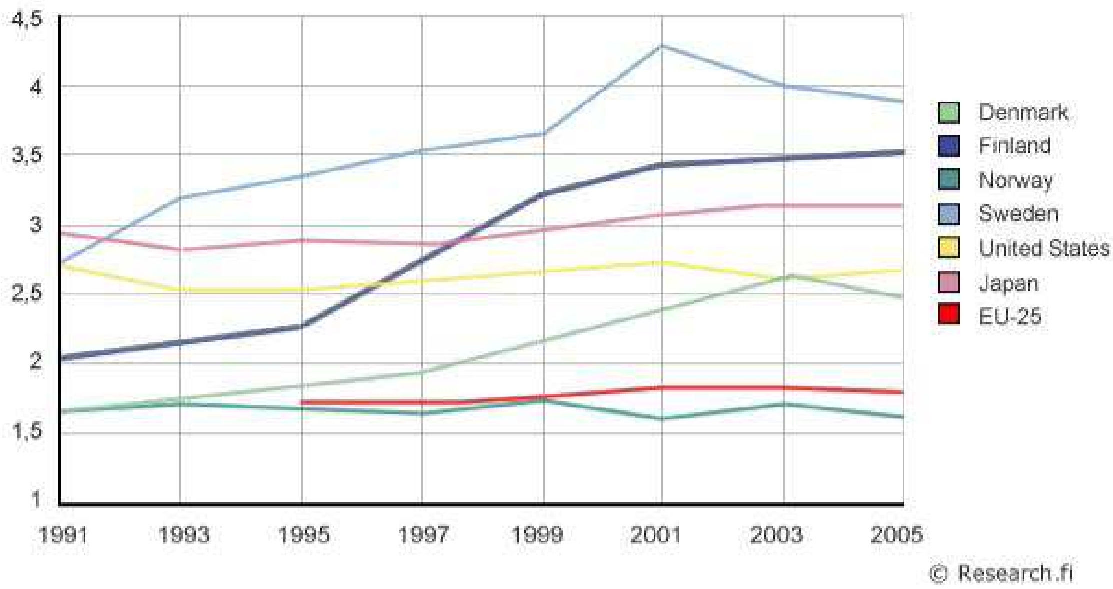
Source: http://www.minedu.fi/OPM/Tiede/tiede-_ja_teknologianeuvosto/kokoonpano/neuvosto.html?lang=en (accessed 4 October 2008).

Table 3: Tekes decisionmaking limits

Amount related to the proposal	Decisionmaker
≤ 150.000/200.000 €	Head of the technology field
≤ 500.000 €	Process leader
≤ 1.700.000 €	Director general
> 1.700.000 €	Board

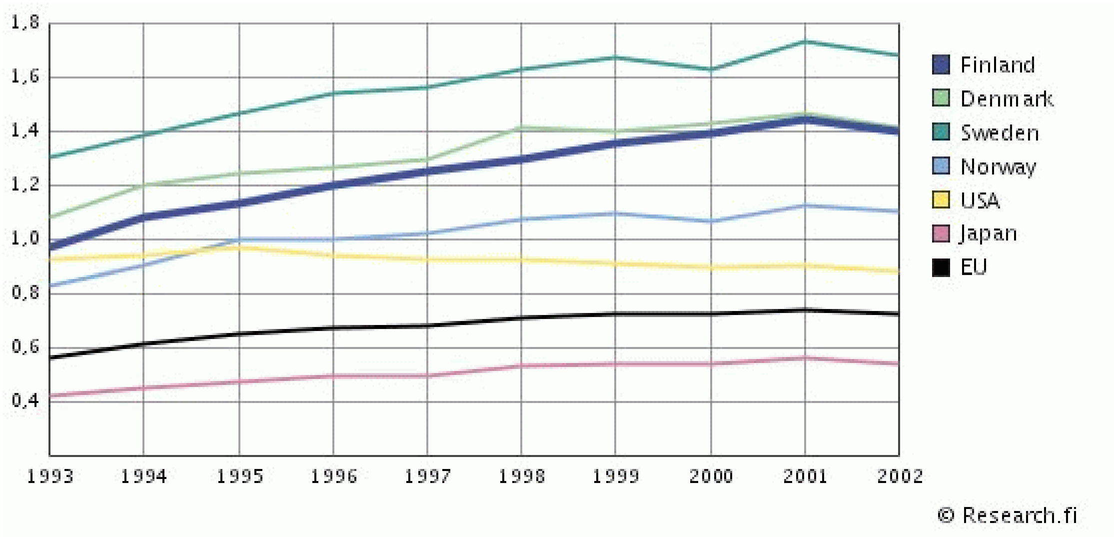
Source: Tanayama (2007).

Figure 1: R&D as a share of GDP, selected countries



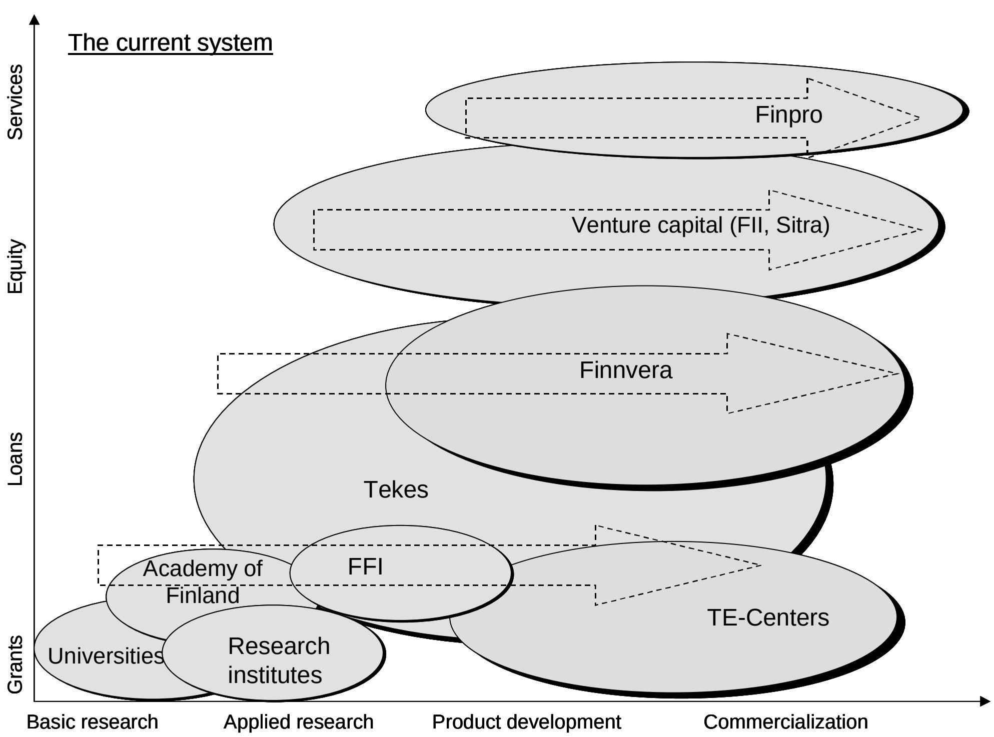
Source: www.research.fi

Figure 2: Scientific publications per thousand inhabitants, selected countries



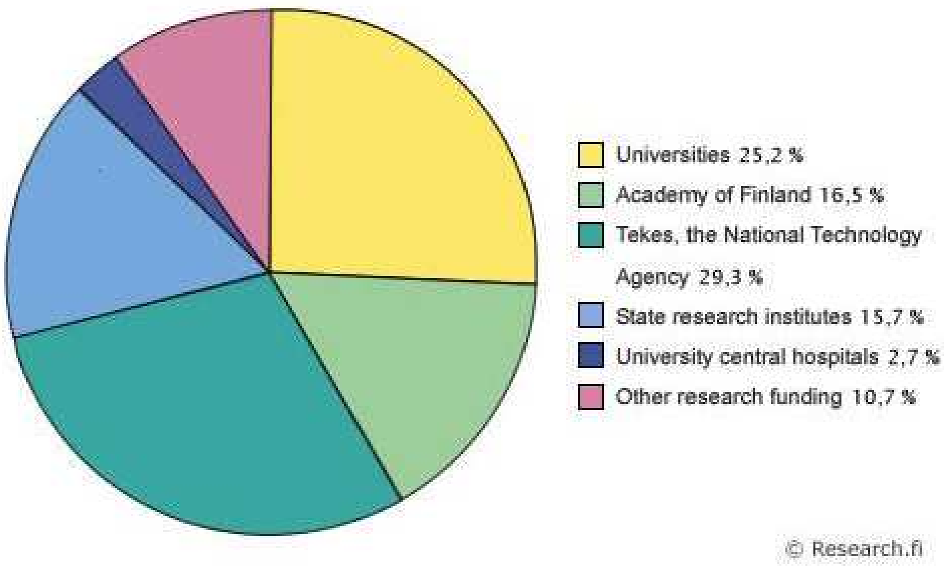
Source: www.research.fi

Figure 3: The Finnish innovation support system



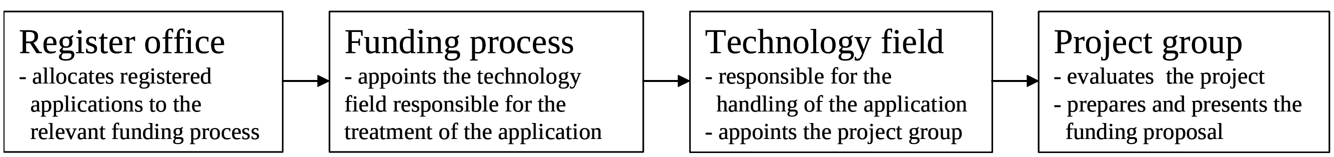
Source: Georghiu et al. (2003).

Figure 4: Relative funding of innovation policy institutions from the Finnish State Budget



Source: www.research.fi

Figure 5: The Tekes decision process



Source: Tanayama (2007).

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